

Research article

Production of Aromatic Hydrocarbons Related Kerosene Fuel from Polystyrene and Polypropylene Waste Plastics Mixture by Fractional Distillation Process

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Abstract

Polypropylene and polystyrene waste plastics mixture to aromatic hydrocarbon related kerosene production was perform laboratory scale batch process. Reactor was using Pyrex glass and fractional column was using also Pyrex glass. Temperature range was for liquefaction process at 200 – 420 °C and fractional distillation column temperature was 205 °C. Laboratory scale batch process polypropylene and polystyrene waste plastics sample was use 300 gm by weight and sample ratio was 50:50. Product fuel density is 0.78 g/ml. Product fuel was analysis by using GC/MS and FT-IR spectrum 100. GC/MS chromatogram analysis result showed carbon chain C₅ to C₂₀ and FT-IR spectrum analysis result showed product fuel has some functional group =C-H, C-CH₃, C-C= - C-C= -CH, CH₃, -CH=CH₂, etc. Fuel can use internal combustion engine and feed for refinery process. **Copyright © IJACSR, all rights reserved.**

Keywords: polypropylene, polystyrene, kerosene, waste plastics, fractional distillation

Introduction

The amount of waste plastics requiring landfill disposal has been rapidly increasing in recent years. Currently, around 20% of the volume and 8% of the weight of all municipal solid waste in the U.S. is made up of waste plastics. [1] Of the approximately 80 billion pounds of plastics currently produced in the United States, most eventually ends up in landfills, with only 2-3% being recycled.[2] In contrast to paper and garbage wastes, most plastics are not readily biodegradable and will remain in the landfill for indeterminate periods. The ever increasing

costs of landfill disposal coupled with a significant public resistance to the creation of new waste landfills has led to increased efforts toward finding economically feasible and environmentally acceptable means of recycling these materials.[3] Plastics are being produced and utilized worldwide at an increasing rate with each subsequent year.[4] Plastics are manufactured for various uses including, but not limited to, consumer packaging, wires, pipes, containers, bottles, appliances, electrical/electronic parts, and automotive parts. Plastics are produced from petroleum and are composed primarily of hydrocarbons but also contain antioxidants and colorants. [5] Plastics once used are not effectively recycled [6] and are difficult to collect from the consumer and then to separate into specific types.[7] Typical household plastic waste consists of \uparrow 63% high- and low-density polyethylene (HDPE, LDPE), 11% polypropylene (PP), 11% polystyrene (PS), 7% polyethylene terephthalate (PET), and 5% polyvinyl chloride (PVC). [8] Most polymers, however, will give a mixture of products that must undergo extensive separation to recover a monomer stream, and the de-polymerization of postconsumer commingled (mixed) waste plastics to pure monomers does not appear feasible. Thus, other processes for dealing with commingled waste plastics have been proposed including pyrolysis,[9-14] gasification,[15] and catalytic co-liquefaction.[16] In a pyrolysis type process, such as the Conrad process,[11,12] shredded mixed plastics are heated in the absence of oxygen and de-polymerized back into liquids (70-80%) and gases (5-10%). The gases are burned in the process to provide heat needed for the de-polymerization and pyrolysis. Although the pyrolysis process produces substantial quantities of light naphtha range (-205 °C) liquids, significant quantities of heavier gas oil range liquids are also reduced. The heavier gas oil fraction is potentially valuable as upgrading feedstock for naphtha range material with an end use in the transportation fuel pool.

Scott et al. [17] investigated the fast pyrolysis of low-density polyethylene at 600 °C using an activated carbon fluidized bed reactor. They observed feed conversions of \uparrow 80% into gaseous and liquid products, the latter having a high aromatic content. Over 60% of the pyrolysis product was a liquid hydrocarbon fraction of relatively low boiling range. Yamamoto and Takamiya [18] studied the cracking of polyethylene on $\text{SiO}_2\text{-Al}_2\text{O}_3$ under N_2 . In the absence of a catalyst, the pyrolysis yielded 77.1% of gas at 600 °C. The products were mainly ethylene, propylene, and 1-butene. With $\text{SiO}_2\text{-Al}_2\text{O}_3$ as catalyst, a higher gas yield (87.8%) was obtained even at 450 °C. The gas consisted mainly of isobutylene (45.6%). Uemichi and co-workers [19] studied the pyrolysis of polyolefins to aromatic hydrocarbons under N_2 using activated carbon-supported metal (Pt, Fe, or Mo) catalysts. Polyethylene was converted to $\text{C}_6\text{-C}_{14}$ aromatics at 526 °C with a selectivity of \uparrow 60%. Benzene was produced as the main aromatic component over the Pt-containing catalyst, while catalysts containing Fe or Mo yielded preferentially toluene. The presence of methyl branching in polypropylene was found to be unfavorable for the formation of aromatics. [20] Audisio and Silvani [21] studied the catalytic degradation of polypropylene under vacuum (10^{-1} Torr). Catalysts, e.g., Al_2O_3 , SiO_2 , $\text{SiO}_2\text{-Al}_2\text{O}_3$, and Y-type zeolites, were screened at 200, 400, and 600 °C. The authors concluded that $\text{SiO}_2\text{-Al}_2\text{O}_3$, HY, and REY were the most efficient catalysts for this reaction. Smith [22] studied the catalytic cracking of byproduct (amorphous) polypropylene into fuel oil with a $\text{SiO}_2\text{-Al}_2\text{O}_3$ catalyst. In another study, Carle and Hann [23] mixed up to 2.5% of amorphous polypropylene into the feed of a fluid catalytic cracker.

Materials and Method

Polypropylene and polystyrene waste plastics was collected from Natural State Research facility kitchen area. Collected waste plastics were food container and it was wash with liquid soap and tap water. Polypropylene and polystyrene waste plastics cut into small pieces and transfer into glass reactor for liquefaction process. Full process diagram showed into figure 1 for visual understanding. For experimental purpose required materials was waste plastics mixture (PP and PS), glass reactor, temperature controller, fractional distillation column (2 feet high), thermal cloth, residue collection container, sodium hydroxide and sodium bicarbonate solution with 0.25 normality,

small pump, Teflon bag, fraction fuels collation container, fuel cleaning device, final fuel collection container for kerosene fuel. This experiment main goal was kerosene grade fuel collection from PP and PS waste plastics mixture.

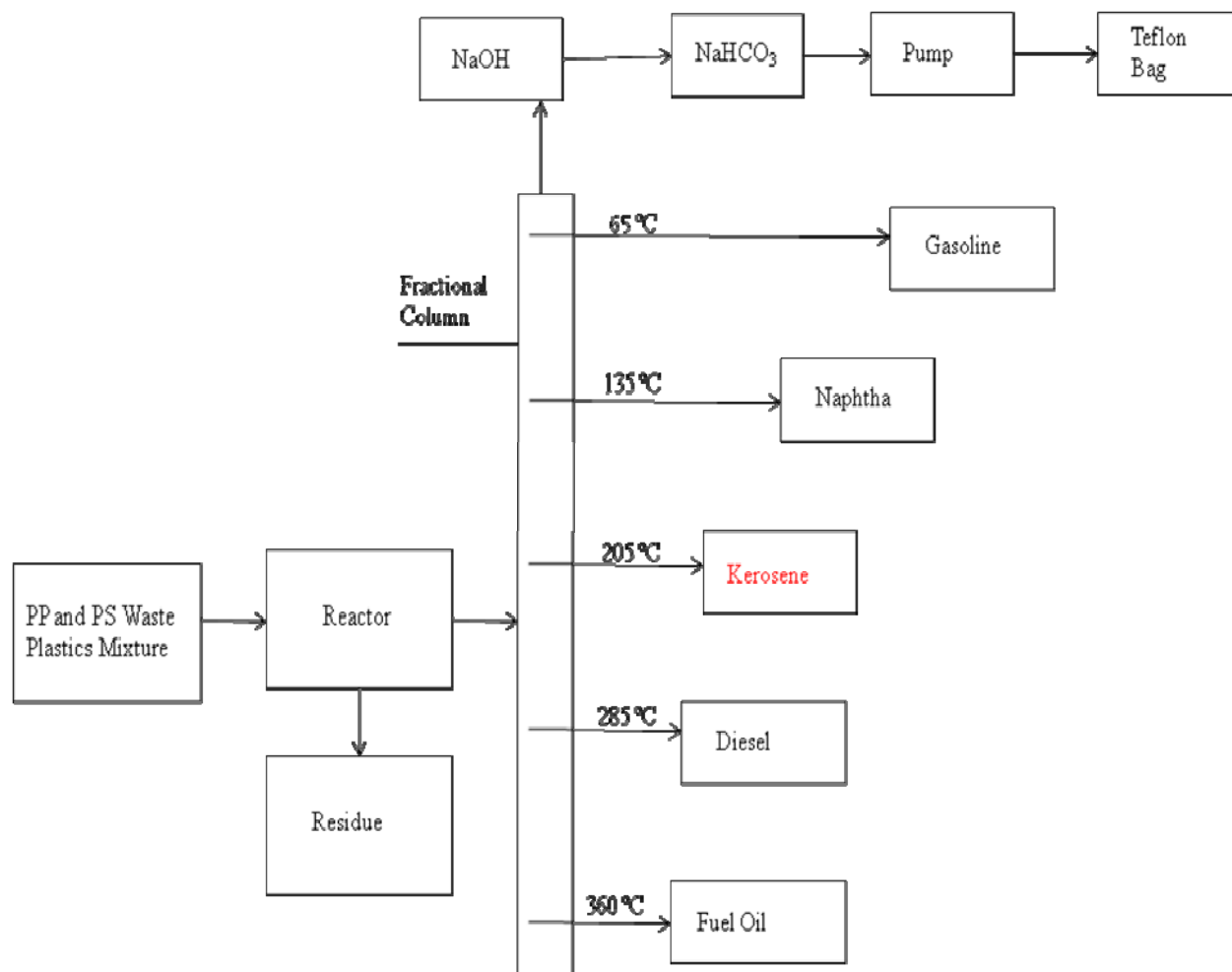


Figure 1: PP and PS waste plastic to kerosene production by fractional distillation process

Mixture waste plastics transfer into glass reactor inside and placed into heating chamber for liquefaction process and temperature range was 200 – 420 °C. Temperature controlled purpose was use variac meter because sometimes temperature profile need to increase and decrease for good quality production. Reactor temperature can go up to 500 °C and reactor was electrical reactor. Full setup procedure was tightening enough to prevent gas loss during production period. Fractional distillation column temperature was controlled with thermal heating pad. Waste plastics mixture was heated up from 200 °C to up to 420 °C and waste plastics mixture was melted, turn into liquid then liquid turn into vapor, vapor pass through fractional distillation column at the end fuels was collected different grade based on desire temperature wise. In this experiment main goal was kerosene collection at 205 °C. Fractional distillation process waste plastic to fuels collection process liquid solution was use for light negative fraction cleaning purpose. Small pump and Teflon bag was use for light fraction storage purpose. Fraction fuels was collected based on compounds boiling point temperature wise such as light fraction fuel was collected upper part

then according to rest of fraction fuels was collected. Collected fuel was clean with purification system wise and purified kerosene fuel was use for GC/MS analysis. 17% kerosene was collected from polypropylene and polystyrene waste plastics mixture. Rest of percentage was other grade fuels, residue and light fraction gas mixture. 300 gm waste plastics mixture to kerosene grade fuel was produced 51gm. Total experiment run time was 4.50 hours.

Results and Discussion

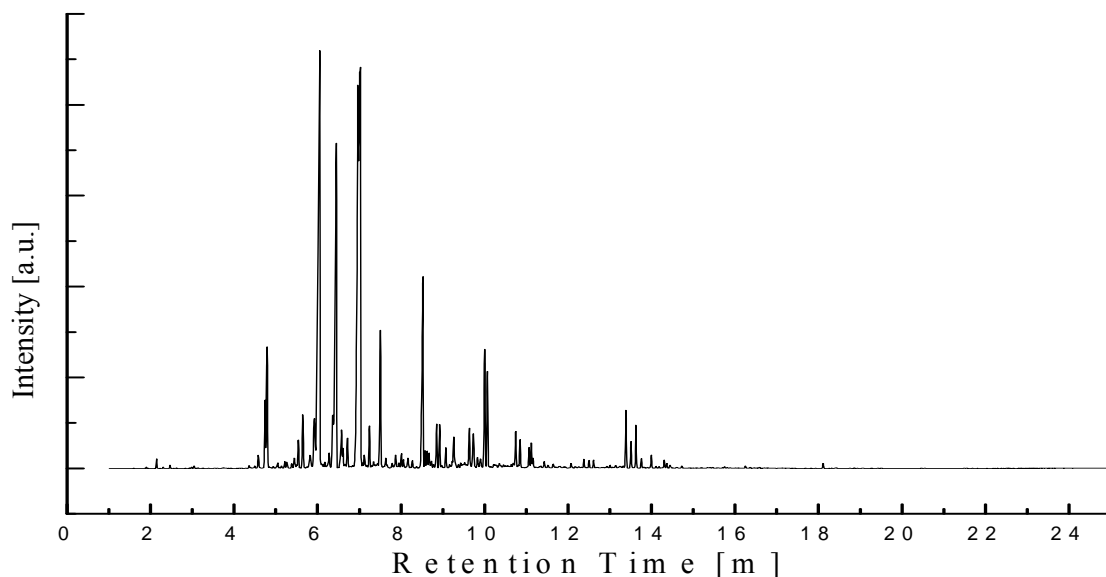


Figure 2: GC/MS chromatogram of polypropylene and polystyrene waste plastics mixture to kerosene

Table 1: GC/MS chromatogram compounds list of polypropylene and polystyrene waste plastics mixture to kerosene

Number of Peak	Retention Time (min.)	Trace Mass (m/z)	Compound Name	Compound Formula	Molecular Weight	Probability %	NIST Library Number
1	1.90	43	Pentane	C ₅ H ₁₂	72	74.5	114462
2	1.94	55	2-Methyl-1-butene	C ₅ H ₁₀	70	14.2	243
3	2.30	43	Pentane, 2-methyl-	C ₆ H ₁₄	86	40.1	61279
4	2.46	56	1-Pentene, 2-methyl-	C ₆ H ₁₂	84	41.3	495
5	2.62	69	Cyclopropane, 1,1,2-	C ₆ H ₁₂	84	17.8	152055

			trimethyl-					
6	2.94	67	1,3-Butadiene, 2,3-dimethyl-	C ₆ H ₁₀	82	9.11	62227	
7	2.98	79	1,3-Cyclopentadiene, 5-methyl-	C ₆ H ₈	80	13.0	419	
8	3.04	56	1-Pentene, 2,4-dimethyl-	C ₇ H ₁₄	98	38.5	114435	
9	3.14	81	2,4-Dimethyl 1,4-pentadiene	C ₇ H ₁₂	96	55.9	114468	
10	3.24	78	Benzene	C ₆ H ₆	78	56.4	228009	
11	3.39	43	Hexane, 3-methyl-	C ₇ H ₁₆	100	46.6	231738	
12	3.75	81	1,3-Pentadiene, 2,4-dimethyl-	C ₇ H ₁₂	96	31.5	114450	
13	3.78	81	3,5-Dimethylcyclopentene	C ₇ H ₁₂	96	14.1	113640	
14	3.36	79	1-Methylcyclohexa-2,4-diene	C ₇ H ₁₀	94	10.6	298961	
15	4.49	56	1-Hexene, 2,5-dimethyl-	C ₈ H ₁₆	112	23.7	152682	
16	4.58	69	2-Hexene, 3,5-dimethyl-	C ₈ H ₁₆	112	18.7	149385	
17	4.75	43	Heptane, 4-methyl-	C ₈ H ₁₈	114	59.3	113916	
18	4.79	91	Toluene	C ₇ H ₈	92	61.6	291301	
19	4.93	70	Heptane, 3-methylene-	C ₈ H ₁₆	112	16.6	288517	
20	5.05	56	1-Heptene, 2-methyl-	C ₈ H ₁₆	112	53.6	113675	
21	5.09	70	Heptane, 3-methylene-	C ₈ H ₁₆	112	35.6	288517	
22	5.13	55	3-Octene, (Z)-	C ₈ H ₁₆	112	9.30	61767	
23	5.21	95	Cyclopentene, 1,2,3-trimethyl-	C ₈ H ₁₄	110	13.9	113461	
24	5.26	109	1,2,4,4-	C ₉ H ₁₆	124	47.8	113515	

Tetramethylcyclopentene							
25	5.38	109	Cyclohexene, 3,3,5-trimethyl-	C ₉ H ₁₆	124	23.0	34526
26	5.44	69	3-Heptene, 2,6-dimethyl-	C ₉ H ₁₈	126	15.4	37342
27	5.54	83	Cyclopentane, 1,1,3,4-tetramethyl-, cis-	C ₉ H ₁₈	126	12.5	27589
28	5.65	43	Heptane, 2,4-dimethyl-	C ₉ H ₂₀	128	32.9	2657
29	5.81	83	2-Hexene, 4,4,5-trimethyl-	C ₉ H ₁₈	126	19.1	26930
30	5.92	69	Cyclohexane, 1,3,5-trimethyl-	C ₉ H ₁₈	126	36.8	232155
31	6.05	43	2,4-Dimethyl-1-heptene	C ₉ H ₁₈	126	58.8	113516
32	6.28	67	cis-1,4-Dimethyl-2-methylenecyclohexane	C ₉ H ₁₆	124	14.4	113533
33	6.45	91	Ethylbenzene	C ₈ H ₁₀	106	59.1	158804
34	6.58	109	Cyclohexene, 3,3,5-trimethyl-	C ₉ H ₁₆	124	48.6	114765
35	6.96	104	Styrene	C ₈ H ₈	104	16.4	291542
36	7.02	104	Bicyclo[4.2.0]octa-1,3,5-triene	C ₈ H ₈	104	42.6	154588
37	7.24	82	1,6-Octadiene, 2,5-dimethyl-, (E)-	C ₁₀ H ₁₈	138	6.84	62075
38	7.50	105	Benzene, (1-methylethyl)-	C ₉ H ₁₂	120	52.1	228742
39	7.63	43	1-Octanol, 2,7-dimethyl-	C ₁₀ H ₂₂ O	158	4.40	61714
40	7.79	56	2-Methyl-1-nonene	C ₁₀ H ₂₀	140	8.16	113561
41	7.86	117	Benzene, 2-propenyl-	C ₉ H ₁₀	118	17.2	114744
42	7.95	43	cis-3-Decene	C ₁₀ H ₂₀	140	7.70	113558

43	8.01	91	Benzene, propyl-	C ₉ H ₁₂	120	63.5	228007
44	8.06	57	Nonane, 4-methyl-	C ₁₀ H ₂₂	142	30.1	3834
45	8.17	105	Benzaldehyde	C ₇ H ₆ O	106	62.7	291541
46	8.27	105	Benzene, 1,3,5-trimethyl-	C ₉ H ₁₂	120	19.6	20469
47	8.53	117	α-Methylstyrene	C ₉ H ₁₀	118	33.4	2021
48	8.59	69	2-Decene, 7-methyl-, (Z)-	C ₁₁ H ₂₂	154	5.72	61984
49	8.63	69	3-Undecene, (Z)-	C ₁₁ H ₂₂	154	6.02	142598
50	8.67	69	Nonane, 2-methyl-3-methylene-	C ₁₁ H ₂₂	154	6.97	61011
51	8.85	57	Decane, 4-methyl-	C ₁₁ H ₂₄	156	7.28	113875
52	8.93	57	Nonane, 2,6-dimethyl-	C ₁₁ H ₂₄	156	6.71	61438
53	9.07	56	2-Decene, 7-methyl-, (Z)-	C ₁₁ H ₂₂	154	5.59	61984
54	9.26	117	Benzene, 2-propenyl-	C ₉ H ₁₀	118	13.0	114744
55	9.37	69	Cyclohexane, 2-ethyl-1,3-dimethyl-	C ₁₀ H ₂₀	140	5.33	63060
56	9.43	56	1-Ethyl-2,2,6-trimethylcyclohexane	C ₁₁ H ₂₂	154	11.5	69815
57	9.52	91	Benzene, 3-butenyl-	C ₁₀ H ₁₂	132	45.1	113933
58	9.63	57	1-Octanol, 2-butyl-	C ₁₂ H ₂₆ O	186	7.47	114639
59	9.73	91	Benzeneacetic acid, 4-tridecyl ester	C ₂₁ H ₃₄ O ₂	318	12.9	282023
60	9.83	43	Cyclohexane, 2-propyl-1,1,3-trimethyl-	C ₁₂ H ₂₄	168	5.56	69818
61	10.00	69	Cyclooctane, 1,4-dimethyl-, trans-	C ₁₀ H ₂₀	140	3.18	61408
62	10.07	57	1-Decene, 2,4-dimethyl-	C ₁₂ H ₂₄	168	3.44	61110

63	10.36	57	Tridecane	$C_{13}H_{28}$	184	11.1	61976
64	10.56	43	Cyclopropanol, 1-(3,7-dimethyl-1-octenyl)-	$C_{13}H_{24}O$	196	11.6	55804
65	10.64	83	Hexane, 1-(isopropylidencyclopropyl)-	$C_{12}H_{22}$	166	9.62	6216
66	10.69	69	9-Octadecyne	$C_{18}H_{34}$	250	10.5	62812
67	10.75	43	1-Dodecanol, 3,7,11-trimethyl-	$C_{15}H_{32}O$	228	3.85	114065
68	10.85	43	1-Dodecanol, 3,7,11-trimethyl-	$C_{15}H_{32}O$	228	4.68	114065
69	11.07	91	Benzene, (3-methyl-3-butenyl)-	$C_{11}H_{14}$	146	53.5	113578
70	11.12	69	(2,4,6-Trimethylcyclohexyl) methanol	$C_{10}H_{20}O$	156	15.3	113757
71	11.35	91	Benzene, pentyl-	$C_{11}H_{16}$	148	58.5	21390
72	11.43	69	1-Isopropyl-1,4,5-trimethylcyclohexane	$C_{12}H_{24}$	168	31.3	113584
73	11.52	131	Benzene, (3-methyl-2-butenyl)-	$C_{11}H_{14}$	146	49.9	186387
74	11.64	105	Benzene, (1,3-dimethyl-3-butenyl)-	$C_{12}H_{16}$	160	24.6	60931
75	11.70	131	Benzene, (3-methyl-2-butenyl)-	$C_{11}H_{14}$	146	29.1	186387
76	11.78	69	1-Dodecanol, 3,7,11-trimethyl-	$C_{15}H_{32}O$	228	10.1	114065
77	11.80	118	3-Cyclopentylpropionic acid, 3-phenylpropyl ester	$C_{17}H_{24}O_2$	260	29.9	293473
78	11.90	57	Dodecane	$C_{12}H_{26}$	170	5.07	22004
79	11.94	128	2-Naphthalenol, 1,2-	$C_{12}H_{12}O_2$	188	12.7	162634

dihydro-, acetate							
80	12.07	69	Cyclohexane, 2,4-diethyl-1-methyl-	C ₁₁ H ₂₂	154	9.01	61114
81	12.17	69	1-Dodecanol, 3,7,11-trimethyl-	C ₁₅ H ₃₂ O	228	4.31	114065
82	12.38	57	Dodecane, 4,6-dimethyl-	C ₁₄ H ₃₀	198	13.7	45335
83	12.51	57	Dodecane, 4,6-dimethyl-	C ₁₄ H ₃₀	198	12.7	45335
84	12.61	57	Dodecane, 4,6-dimethyl-	C ₁₄ H ₃₀	198	10.1	45335
85	12.93	83	3-Decene, 2,2-dimethyl-, (E)-	C ₁₂ H ₂₄	168	3.82	60857
86	13.01	57	Eicosane	C ₂₀ H ₄₂	282	12.5	53470
87	13.14	43	2-Hexyl-1-octanol	C ₁₄ H ₃₀ O	214	8.40	113807
88	13.39	43	3-Eicosene, (E)-	C ₂₀ H ₄₀	280	4.57	62838
89	13.51	43	2-Isopropyl-5-methyl-1-heptanol	C ₁₁ H ₂₄ O	172	4.68	245029
90	13.75	92	Benzene, heptyl-	C ₁₃ H ₂₀	176	76.3	228243
91	13.99	57	1-Octanol, 2-butyl-	C ₁₂ H ₂₆ O	186	4.76	114639
92	14.11	57	1-Dodecanol, 3,7,11-trimethyl-	C ₁₅ H ₃₂ O	228	5.22	114065
93	14.31	69	1-Octanol, 2-butyl-	C ₁₂ H ₂₆ O	186	4.06	114639
94	14.37	55	(2,4,6-Trimethylcyclohexyl) methanol	C ₁₀ H ₂₀ O	156	11.7	113757
95	14.44	118	Benzene, (1-methylenepentyl)-	C ₁₂ H ₁₆	160	17.2	149206
96	14.73	91	8-Phenyl-1-octanol	C ₁₄ H ₂₂ O	206	14.6	136644
97	16.25	69	Trichloroacetic acid, hexadecyl ester	C ₁₈ H ₃₃ Cl ₃ O ₂	386	3.85	280518

98	18.11	92	Benzene, 1,1'-(1,3-propanediyl)bis-	C ₁₅ H ₁₆	196	93.7	133399
99	18.43	105	Benzene, 1,1'-(1-methyl-1,3-propanediyl)bis-	C ₁₆ H ₁₈	210	86.7	149665
100	19.43	57	1,7-Dimethyl-4-(1-methylethyl)cyclodecane	C ₁₅ H ₃₀	210	15.1	249054

Polypropylene and polystyrene waste plastics mixture to kerosene (3rd fraction) fuel was collected at temperature 205 °C and 3rd fraction fuel was analysis by GC/MS and solvent was carbon disulfide. Capillary column use was for GC/MS analysis. 3rd fraction fuel similar to kerosene grade fuel and kerosene grade fuel density is little higher than gasoline grade fuel. 3rd fraction fuel analysis GC/MS chromatogram shown figure 2 and compounds table shown table 1. 3rd fraction fuel hydrocarbon range showed C₅ to C₂₀ including aromatic group, alcoholic group, oxygen content, and halogen content. 3rd fraction fuel compounds range little higher number carbon range present. Chromatogram analysis result showed 3rd fraction fuel starting compounds is Pentane (C₅H₁₂) (t=1.90, m/z=43) compounds molecular weight 72 and compound probability percentage is 74.5%, 1,1,2-trimethyl-Cyclopropane (C₆H₁₂) (t=2.62, m/z=69) compounds molecular weight 84 and compound probability percentage is 17.8 %, Benzene (C₆H₆) (t=3.24, m/z=78) compounds molecular weight 78 and compound probability percentage is 56.4%, 1-Methylcyclohexa-2,4-diene (C₇H₁₀) (t=3.36, m/z=79) compounds molecular weight 94 and compound probability percentage is 10.6 %, 4-methyl- Heptane (C₈H₁₈) (t=4.75, m/z=43) compounds molecular weight 114 and compound probability percentage is 59.3%, Toluene (C₇H₈) (t=4.79, m/z=91) compounds molecular weight 92 and compound probability percentage is 61.6%, (Z)-3-Octene (C₈H₁₆) (t=5.13, m/z=55) compounds molecular weight 112 and compound probability percentage is 9.30%, 3,3,5-trimethyl-Cyclohexene (C₉H₁₆) (t=5.38, m/z=109) compounds molecular weight 124 and compound probability percentage is 23.0 %, 4,4,5-trimethyl-2-Hexene (C₉H₁₈) (t=5.81, m/z=83) compounds molecular weight 126 and compound probability percentage is 19.1%, Ethylbenzene (C₈H₁₀) (t=6.45, m/z=91) compounds molecular weight 106 and compound probability percentage is 59.1%, (E)-2,5-dimethyl-1,6-Octadiene (C₁₀H₁₈) (t=7.24, m/z=82) compounds molecular weight 138 and compound probability percentage is 6.84%, cis-3-Decene (C₁₀H₂₀) (t=7.95, m/z=43) compounds molecular weight 140 and compound probability percentage is 7.70%, (Z)-7-methyl-2-Decene (C₁₁H₂₂) (t=8.59, m/z=69) compounds molecular weight 154 and compound probability percentage is 5.72 %, 2,6-dimethyl-Nonane (C₁₁H₂₄) (t=8.93, m/z=57) compounds molecular weight 156 and compound probability percentage is 6.71%, 2-butyl-1-Octanol (C₁₂H₂₆O) (t=9.63, m/z=57) compounds molecular weight 186 and compound probability percentage is 7.47%, Tridecane (C₁₃H₂₈) (t=10.36, m/z=57) compounds molecular weight 184 and compound probability percentage is 11.1%, 3,7,11-trimethyl-1-Dodecanol (C₁₅H₃₂O) (t=10.75, m/z=43) compounds molecular weight 228 and compound probability percentage is 3.85%, (3-methyl-2-butenyl)-Benzene (C₁₁H₁₄) (t=11.52, m/z=131) compounds molecular weight 146 and compound probability percentage is 49.9 %, 3- 3-phenylpropyl ester Cyclopentylpropionic acid (C₁₇H₂₄O₂) (t=11.80, m/z=118) compounds molecular weight 260 and compound probability percentage is 29.9 %, 4,6-dimethyl-Dodecane (C₁₄H₃₀) (t=12.38, m/z=57) compounds molecular

weight 198 and compound probability percentage is 13.7%, Eicosane (C₂₀H₄₂) (t=13.1, m/z=57) compounds molecular weight 282 and compound probability percentage is 12.5 %, 8-Phenyl-1-octanol (C₁₄H₂₂O) (t=14.73, m/z=91) compounds molecular weight 206 and compound probability percentage is 14.6 %, bis-1,1'-(1-methyl-1,3-propanediyl) Benzene (C₁₆H₁₈) (t=18.43, m/z=105) compounds molecular weight 210 and compound probability percentage is 86.7%. Kerosene fraction fuel is not ignitable because this fuel hydrocarbon are little heavy. Above analysis all compounds was detected from Perkin Elmer provided NIST library.

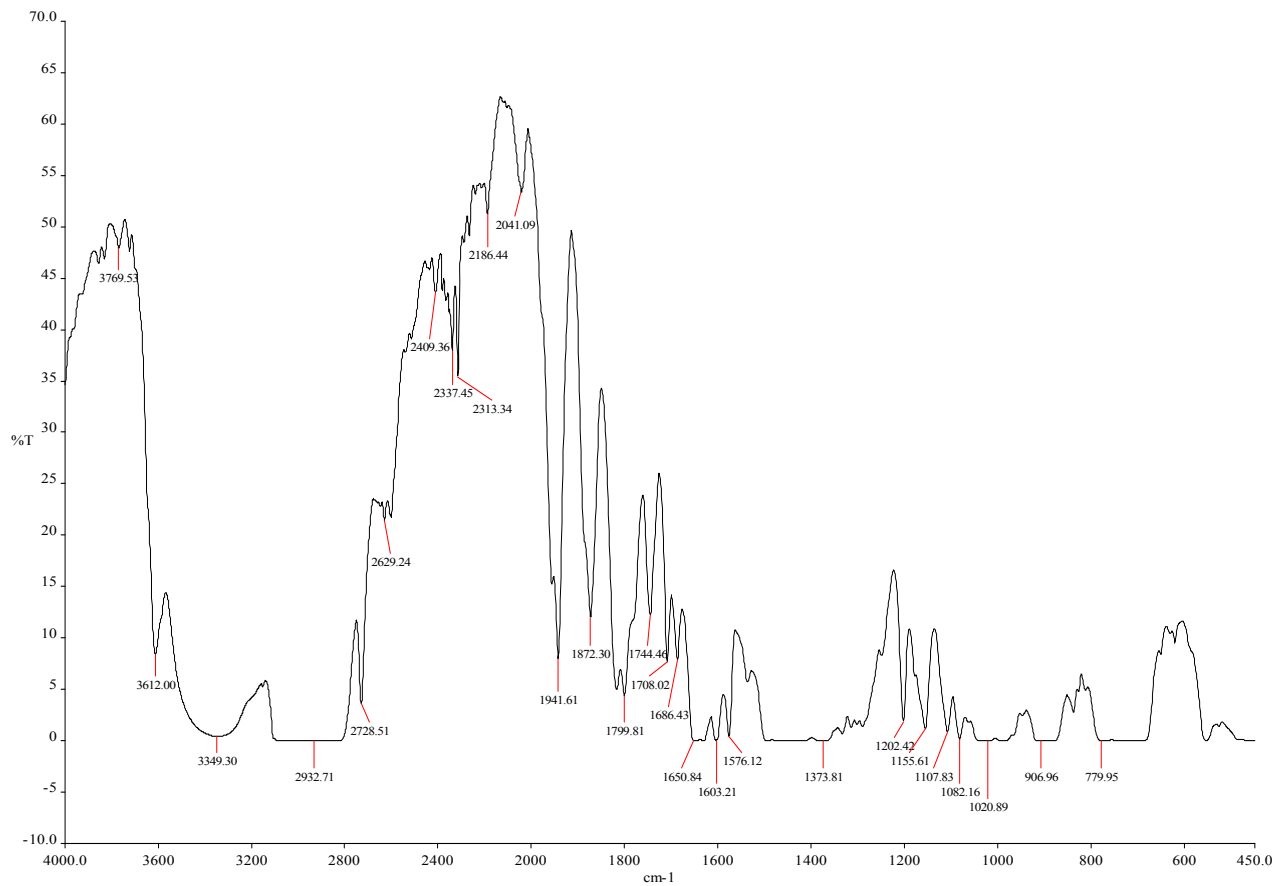


Figure 3: FT-IR spectrum of PP and PS waste plastics mixture to kerosene

Table 2: FT-IR spectrum functional group list of PP and PS waste plastics mixture to kerosene

Number of Wave	Wave Number in cm ⁻¹	Functional Group	Number of Wave	Wave Number in cm ⁻¹	Functional Group
2	3028.17	=C-H	15	1649.10	Amides
3	2958.32	C-CH ₃	16	1604.30	Conjugated

4	2927.08	C-CH ₃	19	1455.89	CH ₃
5	2872.01	C-CH ₃	20	1376.72	CH ₃
6	2729.00	C-CH ₃	25	1030.04	Acetates
9	2186.03	C-C= - C-C= -CH	26	990.18	Secondary Cyclic Alcohol
11	1871.93	Non-Conjugated	27	907.07	-CH=CH ₂
12	1799.96	Non-Conjugated	28	888.02	C=CH ₂
13	1743.25	Non-Conjugated	30	728.99	-CH=CH-(cis)
14	1708.21	Non-Conjugated	31	696.06	-CH=CH-(cis)

FT-IR (spectrum 100) analysis of polypropylene and polystyrene waste plastics mixture to 3rd fractional kerosene fuel (figure 3 and table 2) in accordance with the wave number following types of functional groups are appeared in the analysis such as at the initially wave number 3612.00 cm⁻¹ functional group is Free OH (sharp), wave number 3349.30 cm⁻¹, functional group is Intermolecular H bonds, wave number 2932.71 cm⁻¹ and 2728.50 cm⁻¹ and 2629.24 cm⁻¹ functional group is C-CH₃, wave number 2186.44 cm⁻¹, functional group is C-C= - C-C= -CH, wave number 1872.30 cm⁻¹, 1799.81 cm⁻¹, 1744.46 cm⁻¹, 1650.84 cm⁻¹ functional group is Non-Conjugated, wave number 1603.21 cm⁻¹, functional group is Conjugated etc. As well as at the end of the analysis index wave number 1020.89 cm⁻¹ functional group is Acetates and ultimately wave number 906.96 cm⁻¹ functional group is -CH=CH₂. Some groups are emerged single and double bonded functional groups. Non-Conjugated groups are available in the spectrum analysis of fuel such as several wave numbers are in range of that boundaries. On the other hand methyl and methylene groups are seen in the same analysis spectrum.

Conclusion

Polypropylene and polystyrene waste plastic to kerosene fuel production was successfully without using any kind of catalyst. Fractional distillation process was monitored accurately and temperature profile was setup properly. In this process polypropylene and polystyrene waste plastic to kerosene production percentage was only 17% and product fuel density is 0.78 g/ml. product fuel was analysis by GC/MS and carbon compounds range was C₅ to C₂₀ including aromatic group, aliphatic group, oxygen content and alcoholic content are present. Raw materials was polystyrene and polypropylene mixture for that reason product fuel has aromatic compounds such as Benzene, Toluene, Ethylbenzene, Styrene, α -Methylstyrene, propyl-Benzene, 2-propenyl-Benzene, pentyl-Benzene, heptyl-Benzene, and so on. Product fuel is not ignitable because this fuel hydrocarbon ranges little higher than gasoline grade fuel. This similar to kerosene grade fuel and fuel color is light yellow. Fuel can use internal combustion engine and it can use feed stock refinery process for further modification. Using this technology can convert all PP and PS mixture to kerosene grade fuel for aviation industry. This technology can reduce waste plastic problem from environment at the same time.

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